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Unmanned ground vehicles (UGVs) have become increasingly popular for many intelligence, surveillance, and reconnaissance missions and explosive-ordnance disposal missions in the ongoing conflicts in Iraq and Afghanistan. In these roles, UGVs are credited with saving countless lives. Given the success in missions undertaken so far, there is an interest in arming these UGVs and using them for strike missions. This paper presents three arguments against using unmanned ground vehicles for strike missions in the counterinsurgency operations the U.S. military is conducting in Iraq and Afghanistan. The arguments are based on the Laws of Armed Conflict, the principles of counterinsurgency operations, and the professional military ethic. A counter-argument based on the similarity to Predator strikes is presented and refuted, as are counter-arguments based on saving money and personnel. Finally, this paper recommends that combatant commanders not employ lethally-armed ground robots in the current operations in Iraq and Afghanistan.

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# Pandora's Box: Lethally-Armed Ground Robots in Operations in Iraq and Afghanistan

**by**

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**A paper submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the Department of Joint Military Operations.**

**The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.**

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**Contents**

**Abstract**

Unmanned ground vehicles (UGVs) have become increasingly popular for many intelligence, surveillance, and reconnaissance missions and explosive-ordnance disposal missions in the ongoing conflicts in Iraq and Afghanistan. In these roles, UGVs are credited with saving countless lives. Given the success in missions undertaken so far, there is an interest in arming these UGVs and using them for strike missions. This paper presents three arguments against using unmanned ground vehicles for strike missions in the counterinsurgency operations the U.S. military is conducting in Iraq and Afghanistan. The arguments are based on the Laws of Armed Conflict, the principles of counterinsurgency operations, and the professional military ethic. A counter-argument based on the similarity to Predator strikes is presented and refuted, as are counter-arguments based on saving money and personnel. Finally, this paper recommends that combatant commanders not employ lethally-armed ground robots in the current operations in Iraq and Afghanistan.

# INTRODUCTION

"Soldiers may have armed robots as battle buddies by early next year, according to industry and military officials attending the biennial Army Science Conference. … The system consists of a weapons platform mounted on a Talon robot, a product of the engineering and technology development firm Foster-Miller."[1] With these prophetic words, displayed on the official website of the U.S. Department of Defense Transformation Initiative, the future of lethally-armed ground robots seemed assured. However, the year was 2004 and armed Talon robots (called Special Weapons Observation Remote Direct-Action System, "SWORDS," see Figure 1) didn"t make their combat debut until three years later, when three units were deployed to Iraq in June 2007. Even then, the test was stopped before the robots fired a single shot. The Army never publicly stated exactly what happened. When the science magazine *Popular Mechanics* researched why the test was abruptly halted, they received an indirect response from the deputy project manager of the Robotic Systems Joint Project Office, Duane Gotvald:

> The Special Weapons Observation Remote Direct-Action System (SWORDS) capability is in theater. The SWORDS robot represents a new technological concept currently in the developmental stage. Three robots have been built so far; and while there has been considerable interest in fielding the system, some technical issues still remain and SWORDS is not currently funded. The U.S. Army"s 3rd Infantry Division has used the robots for surveillance and peacekeeping/guard operations. The robot is armed with Squad Automatic Weapon (SAW), M249 Light Machine Gun, and has not yet been used with this weapon in combat.[2]

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All notes appear in shortened form. For full details, see the appropriate entry in the bibliography.

[1] Jewell, "Armed Robots to March Into Battle," http://www.defense.gov/transformation/articles/2004-12/ta120604c.html (accessed 5 October 2010).

[2] Sofge, "The Inside Story of the SWORDS Armed Robot „Pullout" in Iraq: Update," http://www.popularmechanics.com/technology/gadgets/4258963 (accessed 6 October 2010).

Whether the decision to abort the test was made as a result of technical problems or from policy considerations, it was a wise decision. There are several undesirable legal and ethical consequences of using lethally-armed ground robots, especially in the current counter-insurgency operations in Iraq and Afghanistan. In light of these consequences, the CENTCOM and SOCOM combatant commanders should not employ lethally-armed ground robots in Iraq and Afghanistan.

Figure 1. Electrical Engineers from West Point observe QinetiQ's "SWORDS" robot. (*U.S. Army photo.*)

## BACKGROUND

### Defining a Robot

The word "robot" has many connotations: one can think of helpful, even friendly machines such as R2D3 and C3PO from Star Wars, or fearsome, destructive machines such as the "Terminator." Those are, of course, fictional characters, products of sophisticated Hollywood special-effects studios. They bear no resemblance to the robots the military currently uses. In the context of this paper, the term robot has a specific meaning. A robot is an electro-mechanical device that contains three sub-systems: sensor, processor, and actuator.

The sensor sub-system consists of one or more devices that provide data about the robot‟s surroundings. There is usually at least one camera and sometimes there are several to allow the robot or its operator to "see" in multiple directions at once. There may be a thermal imaging device to better operate at night or in conditions of fog, smoke, or dust. Other sensors may include lasers or sonar for range-finding, microphones to convey audio data to an operator, or a compass and GPS receiver to help locate the robot on a map. The processor sub-system is the "brains" of the robot. It has a computer that receives data from the sensors and converts the data into information. For example, it may determine from the laser rangefinder data that there is a wall one foot in front of the robot. The processor sub-system often stores the data or information for later analysis and may also send data back to the operator in real-time via a communications link. The actuator sub-system allows the robot to move around and possibly manipulate its environment using a claw, scoop, or other tool. If the actuator sub-system is ultimately controlled by a human operator who receives data from the sensors via a communications link, the robot‟s behavior is said to be "tele-operated." If the processor sub-system uses the sensor information to control the actuators without human intervention, the robot‟s behavior is said to be "autonomous." If the robot‟s major activities are controlled by a human, but some behaviors are automated by the processing system, the robot is said to operate in a "semi-autonomous" manner. An example of semi-autonomous behavior would be a tele-operated robot that has an obstacle-avoidance feature that prevents the operator from running the robot into a wall. When the robot gets within, for example, four inches of the wall (a distance pre-programmed into the robot) the motor stops. The operator can direct the robot to back up, but the robot will not move closer to the wall.

**Unmanned Lethally-Armed Ground Robots**

Unmanned ground robots (also called unmanned ground vehicles or "UGVs"), the focus of this paper, are robots that are designed to travel on the ground, which contrasts them from unmanned air systems which fly, unmanned surface systems which float and unmanned underwater systems which operate submerged. Most UGVs currently used by U.S. military forces have two roles: intelligence/surveillance/reconnaissance (ISR) or explosive ordnance disposal (EOD). Additionally, the iRobot Corporation has recently developed a robot for mine clearing operations.[3] Robots used for ISR, EOD, or mine clearing operations may have actuators that can cause bodily injury or even death, but I do not consider them in the category of lethally-armed robots. My definition of a lethally-armed robot is one that has an actuator that is *designed* to kill, such as a rifle, shotgun, grenade launcher or anti-tank missile launcher. The previously-described SWORDS is only one of several such robots. QinetiQ (a company that bought out Foster-Miller) has built a SWORDS successor, the Modular Advanced Armed Robotic System ("MAARS") which mounts an M240B machine gun and four 40mm grenade launchers. As an improvement upon the SWORDS, the MAARS is more mobile, more lethal, safer, and easier to control than its predecessor.[4] Another example is Carnegie-Mellon University"s "Gladiator" which also mounts a machine gun and some grenade launchers.[5]

**Autonomous Unmanned Ground Robots**

The discussion in this paper is focused on tele-operated lethally-armed ground robots, where there is a "human in the loop" making decisions about whether to use lethal force. It

[3] Palmisano, "iRobot Demonstrates Weaponized Robot," http://spectrum.ieee.org/robotics/military-robots (accessed 7 September 2010).
[4] http://www.qinetiq-na.com/products-maars.htm (accessed 6 October 2010).
[5] Hanlon, "The Gladiator: US Marines' Unmanned Ground Vehicle," http://www.gizmag.com/go/4484/ (accessed 13 September 2010)

is possible to create a fully-autonomous lethally-armed robot which has no human controlling the weapon system. How this system would make decisions about when to use lethal force is the subject of many research groups. For example, Dr. Ron Arkin at Georgia Tech has done considerable work on control systems for robots that would make decisions which adhere to the Laws of Armed Conflict. However, his work so far is theoretical in nature, outlining frameworks for constructing ethical reasoning systems, but not actually creating such systems.[6] Others debate whether Isaac Asimov's famous Three Laws of Robotics (featured in his book *I, Robot* and the movie of the same name) could be applied in real systems.[7] The consensus is that those "laws" form a convenient fictional device and there is much work still to be done.[8] In order to create truly ethical robots, it would be necessary to program robots to understand and abide by concepts such as the "Soldiers Rules" set forth in FM 3-0 and listed below:

- Soldiers fight only enemy combatants.
- Soldiers do not harm enemies who surrender. They disarm them and turn them over to their superior.
- Soldiers do not kill or torture enemy prisoners of war.
- Soldiers collect and care for the wounded, whether friend or foe.
- Soldiers do not attack medical personnel, facilities, or equipment.
- Soldiers destroy no more than the mission requires.
- Soldiers treat civilians humanely.
- Soldiers do not steal. Soldiers respect private property and possessions.
- Soldiers should do their best to prevent violations of the law of war.
- Soldiers report all violations of the law of war to their superior. [9]

These laws can be difficult even for humans to apply, requiring sophisticated reasoning to determine, for example, who is an "enemy combatant" and define what constitutes "torture."

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[6] Arkin, *Governing Lethal Behavior:Embedding Ethics in a Hybrid Deliberative/Reactive Robot Architecture* , 1.
[7] Woollacott, "Engineers rewrite Asimov's three laws" and Singer, *Wired for War,* 422.
[8] Taylor, "Who's Proposing Ethical Guidelines for Robots?" http://spectrum.ieee.org/robotics/robotics-software (accessed 7 September 2010).
[9] U.S. Army, *Operations.* Field Manual (FM) 3-0, 1-20.

There are currently no robotic control systems that exhibit the high degree of intelligence necessary to determine and apply such concepts. Since this paper focuses on lethally-armed UGVs that could be fielded in the next few years, speculation about technologies that would take years or decades to mature, if they are even possible, is beyond the scope of this analysis.

## SHORT SUMMARY OF POSSIBLE COUNTER-ARGUMENTS

As evidenced by the press coverage of the 2004 Army Science Conference and QinetiQ‟s development of the MAARS after the SWORDS test was halted, there is considerable interest in fielding lethally-armed ground robots, especially by soldiers involved in ground combat.[10] One argument in favor of such systems is that lethally-armed UGVs are simply a natural extension of lethally-armed unmanned air systems (UAS), such as the famous Predator UAS which has attacked high-value targets in many remote locations. However, there are significant differences in how the Predator is employed, compared with how a lethally-armed UGV would be employed. The two situations are not as similar as they might appear. Another argument that is often heard is that arming robots would save soldiers‟ lives. If a robot on an ISR mission encountered hostile fire, the robot could shoot the enemy while keeping the soldier safely out of harm‟s way. While this might be true, protection of our soldiers is not the only consideration. Unarmed robots have served well in ISR missions and will continue to do so and occasionally they have been destroyed by hostile fire, but arming the robot, given the current state of technology, can cause greater problems than it solves. A third argument is that robots are cheaper than soldiers. Their initial cost is less than training a soldier and robots do not require salaries, health insurance, or pensions.

[10] Jewell, "Armed Robots to March Into Battle," http://www.defense.gov/transformation/articles/2004-12/ta120604c.html (accessed 5 October 2010).

Replacing soldiers with armed robots would allow a military to greatly reduce personnel costs. However, with current technology, each robot requires its own operator, so a military with a robot force requires at least as many soldiers as one without. That military might even require *more* soldiers, since someone needs to repair damaged robots. Additionally, as will be discussed in the next section, substituting machines for people does not make sense for many types of missions. "Treads on the ground" are not substitutes for "boots on the ground."

## ANALYSIS

### Current Ground Robot Missions

The military has deployed at least 6,000 UGVs in Iraq and Afghanistan.[11] Two popular models are the iRobot Packbot (which comes in various configurations) and the QinetiQ Talon. These are both "man-portable" robots weighing 50-100 lbs and travel relatively slowly (up to about six miles per hour). They are typically used by dismounted soldiers in a tele-operated configuration to explore under vehicles and inside buildings, tunnels and caves as a mechanical "point man." Each robot requires one soldier to operate it using a proprietary control unit. The UGV operator must be in close proximity to the robot, rather than hundreds or thousands of miles away, as is often the case with unmanned aerial systems. The reason the UGV operator cannot be a continent away is simply due to the finite speed of light and the confined areas in which the robot is maneuvering. Even though light travels 186,000 miles per second, inter-continental control signals are relayed through geostationary satellites 22,300 miles above the earth. It takes about ¼ second for the video signal to reach the operator and another ¼ second for the operator's command, such as "turn left" or "stop" to get back to the robot, assuming the operator made an instantaneous

[11] Department of Defense, *FY2009-2034 Unmanned Systems Integrated Roadmap*, 3.

decision. A UGV moving at three feet per second (a slow walking pace) in a tunnel or building would have covered 18 inches in that ½ second. If the UGV turns a corner and suddenly finds an IED or other obstacle in the way, by the time the operator in the U.S. saw that obstacle and commanded the UGV to stop, the UGV would have already hit it. On the other hand, the UAS operator based in Nevada does not have to worry about his Predator aircraft in Pakistan suddenly encountering a tree or a mountain: those obstacles can be seen from much longer distances.

Even with locally-controlled UGVs, the operator cannot be miles away. Current methods for communicating with UGVs use ultra-high-frequency radios whose signals are severely attenuated by common building materials such as concrete, stone and steel. In urban environments the operator must therefore be within a few dozen yards of the robot. Unlike unmanned air systems which could be operated by non-military personnel safely located hundreds or thousands of miles away, UGVs are operated by nearby uniformed military service members who may not be in a safe area.

As previously mentioned, a typical UGV has at least one camera which is transmitting video feeds back to the operator who is a few dozen yards (or at most a few hundred yards) away. The operator can use the robot to investigate the inside of buildings and tunnels and either determine that the area is safe, or if the robot gets attacked, the area is unsafe. If the robot gets attacked, wouldn‟t it be preferable for the soldiers outside to have the robot just shoot back? There are many who would advocate this, but I argue that arming robots for this type of mission is counterproductive for three reasons: their use (1) increases the likelihood of violating the Law of Armed Conflict, (2) violates important principles

necessary for successful counterinsurgency operations, and (3) contravenes the professional military ethic.

**Law of Armed Conflict Consequences**

The first reason that combatant commanders should not employ lethally-armed ground robots comes from the Law of Armed Conflict ("LOAC") and the Just War theory on which LOAC is based. The LOAC requires that soldiers discriminate between combatants and non-combatants. Only combatants are legal targets and even then a combatant who is wounded or who has surrendered cannot be attacked. In the conflicts in Iraq and Afghanistan, it can be extremely difficult to determine who is actually a combatant, especially since many of the insurgents blend right in to the population. They do not wear uniforms, they may not be part of an organized force, and they may act like civilians most of the time. Under these circumstances, the commanders of coalition forces have carefully crafted Rules of Engagement ("ROE") to help soldiers determine under what circumstances and at whom they may employ lethal force. For soldiers in the heat of combat, it can be difficult to apply these ROE to a particular situation and occasionally innocent civilians are killed. When a soldier is operating a robot, rather than being able to employ all five of his senses to assess the situation, he is limited to whatever sensors are on the robot, usually a camera and a microphone. Cameras on the UGV have lower resolution and smaller fields of view than the human eye, so the soldier will have a poorer image of the situation than if he were viewing it directly. In addition, since the soldier is relatively close to the robot, the soldier may also be in danger. The soldier not only has to concentrate on the data the robot is sending him, but also on paying attention to his immediate surroundings to ensure his personal safety. This combination of distraction and lack of sensory fidelity from the UGV

make it more difficult for soldiers to accurately determine the status of their intended target, increasing the likelihood that they will make a mistake and violate the LOAC.

**Counterinsurgency Considerations**

The second reason that combatant commanders should not employ lethally-armed ground robots is that they are counterproductive in counterinsurgency (COIN) operations described in Joint Publication (JP) 3-24, *Counterinsurgency Operations*, Field Manual (FM) 3-24, *Counterinsurgency*, and FM 3-24.2, *Tactics of Counterinsurgency*. There are several reasons why lethally-armed robots are counterproductive: First, force must be used precisely. Soldiers should not use excessive force and they must make sure that noncombatants are protected.[12] As already discussed, using lethally-armed UGVs increases the chances of unnecessary (and illegal) injury to noncombatants and damage to their property. Moreover, not only must noncombatants" lives and property be protected, but also their dignity.[13] Driving a robot into a home and opening fire hardly shows respect for the dignity of the occupants. Second, FM 3-24 makes an insightful observation, "*Who* wields force is also important" (emphasis added).[14] In the context of the FM, this sentence refers to the desirability of using host nation forces, especially police forces, in stability operations wherever feasible, rather than foreign military units. However, in the larger context, it does literally apply. Sending in lethally-armed robots does not help to increase the legitimacy of the host nation government, win over a local population, and break the bond between the insurgent and the local population. Rather, it has the opposite effect. It indicates to the population that U.S. forces are unwilling to become personally involved. The U.S. would rather send in machines knowing that innocents might be killed than risk the injury or death

[12] U.S. Army, *Counterinsurgency.* Field Manual (FM) 3-24, 1-25.
[13] Ibid, 7-5.
[14] Ibid, 1-25.

of its own soldiers. One of the paradoxes of COIN is that successful operations require less force, not more, and entail more risk to soldiers, not less.[15]

**Ethical Considerations – The Nature of the Military Profession**

Finally, the nature of the military profession demands that soldiers accept some risk in order to accomplish missions. Interviews with officers who led operations in the Balkans revealed a disturbing trend, "I tell my men every day there is nothing there worth one of them dying for."[16] This view was expressed by a mid-grade officer to senior class cadets at West Point during a panel discussion. Even more disturbing, this assertion was not just a rogue officer"s opinion: it was backed up by the officer"s battalion commander, who indicated that he was simply following guidance promulgated from higher headquarters. These officers indicated that there were many instances of force protection being the overriding factor in deciding when, whether, or how to undertake a mission. Although there is a popular misconception that the American people are completely risk-averse and will not tolerate any U.S. casualties, studies have shown this is not the entire story. When political leaders have articulated the need for military intervention and the U.S. population supports the reasons for intervention and is convinced that the government intends to see the operation through to a successful conclusion, the public accepts that casualties will occur.[17] The professional military ethic is derived from the essential purpose of the military: to protect society. The military protects those who cannot protect themselves and in exchange for the right to inflict harm, members of the military must accept that they are also subject to being harmed while

[15] Ibid, 1-27.
[16] Nagl, *Army Professionalism, the Military Ethic, and Officership in the 21st Century*, 1.
[17] Ibid, 24.

discharging their duty.[18] Using lethally-armed UGVs to inflict harm for the sole purpose of preventing harm to oneself runs counter to this ethic.

This degradation in the professional military ethic was not just a passing phenomenon in the 1990s. Although chapter 7 of FM 3-24, *Counterinsurgency,* is entitled "Leadership and Ethics for Counterinsurgency," the values espoused in this chapter are not universally held by the soldiers deployed in Operations Iraqi Freedom and Enduring Freedom. In 2006, the Commanding General of Multinational Forces-Iraq, GEN Casey, requested that a study of the ethics of soldiers be included as part of the annual Mental Health Advisory Team (MHAT) survey. The team conducted an anonymous survey of 1320 Soldiers and 447 Marines serving in Iraq. Since there were no readily-available survey questions for assessing the ethics of soldiers in battle, the team created a custom set of questions based on four areas: soldier attitudes, ethical behaviors, willingness to report ethical violations committed by other soldiers, and impression of their ethics training (if any).[19] The survey found that only about forty percent agreed that non-combatants should be treated with dignity and respect. A similar proportion thought that torture should be allowed to save the life of a fellow Soldier or Marine. Approximately ten percent reported mistreating noncombatants or damaging their property.[20] Only forty percent of Marines and fifty-five percent of Soldiers said they would report a unit member for injuring or killing a non-combatant.[21] Given that these are self-reported quantities, it is possible that the extent of the problem is larger.

These behaviors and attitudes are intentional, not the result of ignorance. Over eighty percent of Soldiers and Marines reported receiving training in the proper treatment of non-

[18] Orend, *The Morality of War*, 107.
[19] Office of the Surgeon General, MNF-I and Army Medical Command *Mental Health Advisory Team (MHAT) IV Operation Iraqi Freedom 05-07 Final Report*, 34.
[20] Ibid, 35-36.
[21] Ibid, 37.

combatants and approximately eighty percent agreed their training was adequate.[22] The survey was repeated in 2007, but in a slightly different manner. The 2007 survey did not report on the attitudes of soldiers, only their actions, their willingness to report unethical behavior, and their impressions of their training. However, the 2007 survey was also conducted in Afghanistan, whereas the 2006 survey only covered Iraq. The MHAT team surveyed a greater number of soldiers than the previous year: 2,279 soldiers in Iraq and 699 soldiers in Afghanistan. Nonetheless, nearly all the ethics results were statistically identical across all three surveys.[23] From Iraq in 2006, to Iraq in 2007, to Afghanistan in 2007, the only significant difference was that only seventy percent of soldiers in Afghanistan reported receiving adequate ethics training (compared to eighty percent for Iraq).[24] MHAT surveys were conducted again in 2008 in both Iraq and Afghanistan but the team did not survey ethics topics. The report did not even mention why ethics was omitted. The 2008 survey, which was released in May 2009, is the most recent survey publicly available.

It is possible that increased emphasis on ethics training (recommended in the MHAT reports) have increased the ethical standards of Soldiers and Marines in the last year, but absent any data I will assume that the attitudes, behaviors, and likelihood of reporting violations is substantially the same as reported in 2006 and 2007. Using robots to inflict harm further distances the soldiers from the effect of their actions. Given the Soldiers‟ and Marines‟ attitudes and self-reported behaviors, it would be premature to give them tools that will make it easier and more likely for them to injure non-combatants and damage civilian property.

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[22] Ibid, 37.
[23] Office of the Command Surgeon and Army Medical Command, *Mental Health Advisory Team (MHAT) V Operation Enduring Freedom 8 Afghanistan Final Report*, 175.
[24] Ibid, 177.

**Refutation of Arguments in Favor of Lethally-Armed Robots**

**Analogy to Armed Predator Drones**. One claim made is that an armed UGV is no different than an armed UAS, which the military is already using. For example, the Predator UAS can mount a Hellfire missile and these systems have been used for strike missions in a number of countries. However, there are arguments asserting that these armed UAS are unlawful.[25] Elements of the argument against armed UAS are their use in extrajudicial killings, their use in areas outside the territories of Afghanistan and Iraq, and their operation by CIA personnel who are not "combatants" but are involved in military actions. Those considerations do not apply to the scenarios described above. Soldiers, not civilians, operate UGVs. The soldier is operating the UGV in a combat zone in Iraq or Afghanistan, not a third-party country such as Pakistan or Yemen. And finally, the operator is a few hundred meters away from the UGV and would use it to engage targets he might otherwise engage with his personal weapon. However, one element of the argument against armed UAS does apply to UGVs: lack of discrimination. Mary Ellen O'Connell, a Notre Dame Law School professor specializing in international law, estimates that armed UAS strikes kill 50 unintended victims for every intended target.[26] Of course, the collateral damage from a ground robot armed with an M249 Squad Automatic Weapon should be much less than that from a Hellfire missile. But even assuming that the armed UAS do not violate the Laws of Armed Conflict (and Dr. Raul Pedrozo of the Naval War College International Law Department makes a compelling argument for their legality), [27] there are reasons of military necessity that apply to armed UAS that simply do not apply to armed UGVs. Valid military targets located in remote mountainous areas (or countries where we are not at war) may only

[25] O'Connell, *Unlawful Killing with Combat Drones: A Case Study of Pakistan, 2004-2009.*
[26] Ibid, 2.
[27] Pedrozo, *Use of Unmanned Systems to Combat Terrorism.*

be accessible via the air. The U.S. does not have ground forces operating in the area around the target and sending in a ground force would alert the target (or cause catastrophic political consequences if we invaded, for example, Yemen). Even if the U.S. sent in a ground force, the target would escape long before the ground force could engage him. If the only feasible way of striking at the target is via the air, an armed UAS might be the best method, or at least better than a manned aircraft. A UAS is small and relatively quiet, making it hard to detect from the ground. It has a long loiter time, allowing it to wait until the target emerges from cover. It can strike the target in a location and at a time that minimizes collateral damage. There is no similar argument for lethally-armed UGVs. Soldiers are already operating in close proximity to the UGV and therefore to the target. The UGV is noisier than a soldier, so it is actually more likely that a soldier could sneak up on a target than the UGV could. There is no compelling military reason that the UGV must be used to engage the target.

**Robots Save Lives**. As discussed previously, preventing casualties among U.S. soldiers is a desirable goal, but it is not the only consideration when deciding how to accomplish a mission. Commanders have a duty to take care of their subordinates, but they also have a duty to accomplish their mission in a legal and effective manner. The professional military ethic requires that soldiers take risks, especially for COIN operations to be successful. And despite some soldiers" attitudes, the lives of the civilians who live in Iraq and Afghanistan are at least as important as the lives of our soldiers. Since the difficulty of discriminating among legal and unlawful targets is more difficult with a robot"s sensors, the likelihood of killing an innocent civilian is greater with an armed robot than if the soldier himself made positive identification of the target. Risking civilians in order to save soldiers is unethical.

**Robots Are Cheaper Than Soldiers**. Currently, each robot requires its own operator, so robots do not actually reduce the number of personnel required. There are research programs to provide robots with more autonomy so that a single operator can control more than one robot, but no such systems have been fielded yet. Even when the technology is sufficiently developed to allow one operator to reliably control multiple robots, war is not a business. Just as preserving soldiers lives is an important, but not over-riding consideration, saving money is an important, but not over-riding consideration. In a COIN operation, gaining the trust and support of the local population is necessary to reduce the support for the insurgents. Personal interactions are essential for the success of COIN operations. GEN Petraeus re-iterated the importance of close, personal contact, even to the point of admonishing soldiers not to wear sunglasses so they would be less intimidating to the local population.[28] Saving money but failing to accomplish the mission is not "saving" anything at all.

## CONCLUSIONS AND RECOMMENDATIONS

There is considerable interest in building and fielding lethally-armed UGVs. QinetiQ‟s MAARS UGV is a commercially-available product and other companies have systems under development. It is likely to be just a matter of time before the MAARS or a similar system is again tested in a combat operation. If the test results are better than the 2005 SWORDS test, these systems could be fielded to military units in the next few years. However, employing these systems in counterinsurgency operations in Iraq and Afghanistan would be a mistake for three reasons. First, lethally-armed UGVs are likely to increase the number of violations of the Laws of Armed Conflict. The sensors on current-generation UGVs lack sufficient fidelity to enable the soldier operating the robot to accurately

[28] Petraeus, Memorandum 1 August 2010, 2.

discriminate between lawful and unlawful targets in many environments, leading to an increased chance of killing or injuring a noncombatant. Second, in a COIN operation, the emphasis should be on personal interactions between Soldiers and Marines and the local population. Using robots to remotely engage a target, even if the target is a lawful one, sends a negative message to the local population. One cannot build trust using anonymous, intimidating machines that are bristling with weapons. If we are unwilling to risk our soldiers, we are sending the population the message that the COIN operation (and the security and stability of their country) is not worth much to us. That perception erodes the very heart of COIN: building bonds among the people, the U.S. military and the lawful government and breaking the bonds between the people and the insurgents. Finally, employing lethally-armed UGVs is problematic when the Soldiers and Marines serving in Iraq and Afghanistan have a weakly developed sense of the professional military ethic. Providing them tools such as lethally-armed UGVs that make it easier for them to commit ethical violations would increase the chance that they would actually commit such violations. Despite the allure of such high-tech weaponry and the increased tendency toward technological solutions to military problems, combatant commanders should not employ lethally-armed ground robots in Iraq and Afghanistan.

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